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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

First Semester, M. Tech – Mechanical Engineering (MMDN)

Make-up Examination; July - 2016

Finite Element Method

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Assume suitable missing data if any.

UNIT - I

1	a.	Write a note on : (i) Essential and Non-essential boundary conditions (ii) Story and Weak formulation.	6
	b.	Explain the convergence criteria for interpolation function.	6
	c.	Determine the displacement strain and stress in the bar subjected to concentrated load as shown in Fig.Q1c.	8
2	a.	Derive shape functions for a quadratic bar element and graph them.	8
	b.	For the one dimensional bar fixed at both ends and subjected to uniform temperature rise of 30°C as shown in Fig.Q2b, determine the reaction at fixed ends and the axial stress in the bar. Let E = 200 GPa, A = 24 cm^2, L = 1.2 m and $\alpha = 12.5 x 10^{-6}$ mm/°C.	12

UNIT - II

3	a.	Write a note on limitations of CST and bilinear quadrilateral element (QUAD 4).	4
	b.	What are Lagrange elements? Obtain shape functions for a nine nodded quadrilateral element.	8
	c.	Derive shape functions for a TET 4 element.	8
4	a.	Explain ISO, sub and superparometric elements.	6
	b.	Derive shape functions for a CST element in global co-ordinates.	8
	c.	In nodal coordinates of a triangular element are shown in Fig. Q4c. At an interior point P the x-coordinate is 3.3 and $N_1 = 0.3$. Determine N_2, N_3 and y coordinate.	6

UNIT - III

5	a.	Derive stiffness matrix for an axisymmetric element.	14
	b.	For the element of an axisymmetric body rotating with a constant angular velocity 100 rev/min as shown in Fig. Q5b. Evaluate the approximate body force matrix. Weight density of the material is 7800 kg/m^3.	6
6	a.	Obtain the transformation matrix for a truss element.	6
	b.	Obtain the displacement at node 1, reaction at nodes 2 and 3, stresses and strain in the truss shown in Fig. Q6b. Take; E = 70 GPa, A = 200 mm^2.	14

Contd…2

UNIT - IV

7 a. Using Hermite shape function obtain the stiffness matrix for an Euler-Beroulli beam. 8

b. A simply supported beam of span 6 m and of uniform flexural rigidity EI = $40x10^3$ kN/m^2 is subjected to load as shown in Fig. Q7b. Find the deflection at the point of application of the couple. 12

8 a. Derive consistent mass matrix for a 2 noded bar element. 8

b. For the bar shown in Fig. Q8b with modulus of elasticity E and mass density ρ and cross sectional area A determine the first two natural frequencies (Use lumped mass matrix). 12

UNIT - V

9 a. Derive stiffness matrix for a one dimensional bar element. Considering heat conduction using Gabrkin's method 8

b. Determine the temperature distribution through the composite wall as shown in Fig. Q.9 b. when convection heat loss occurs on the right surface. Assume unit area. 12

10 a. Explain the boundary condition applicable to heat transfer problems. 6

b. For the one dimensional rod shown in Fig. Q.10.b determine the temperature distribution and heat flux. Take; K= 60 W/m°C, h = 800 W/m^{2}°C, T_∞ = 10°C. The temperature at the left end of the rod is constant at 100°C. Take three elements. 14

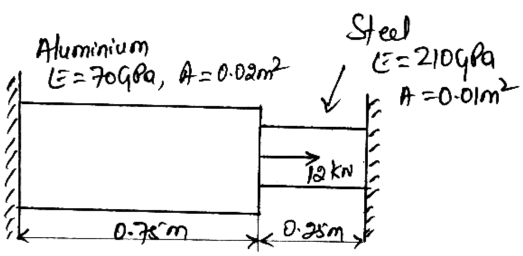

Fig. Q1c

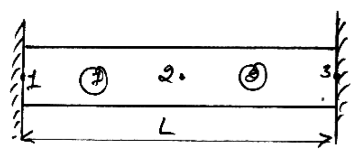

Fig. Q9b

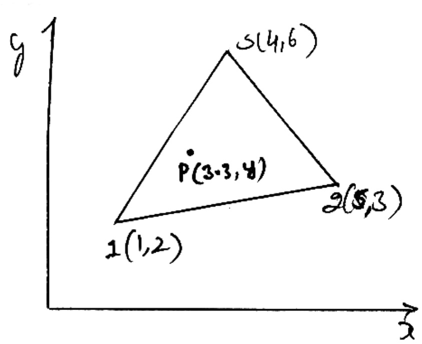

Fig. Q4c

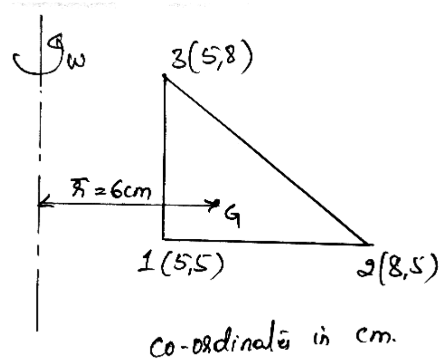

Fig. Q5b

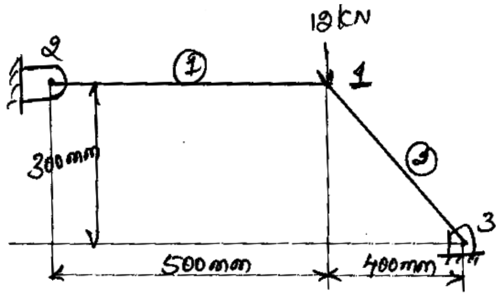

Fig. Q6b

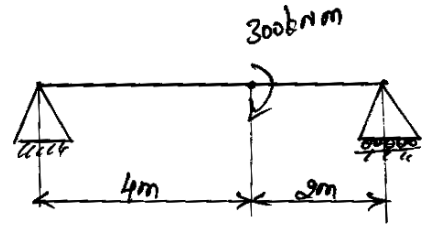

Fig. Q7b

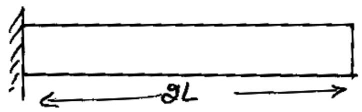

Fig. Q8b

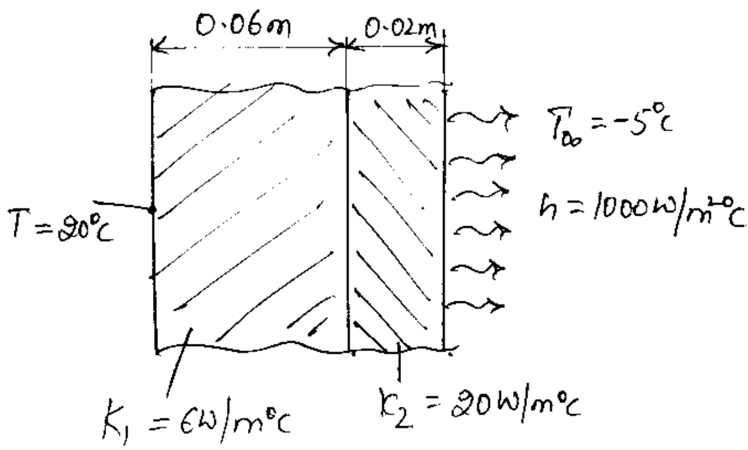

Fig. Q9b

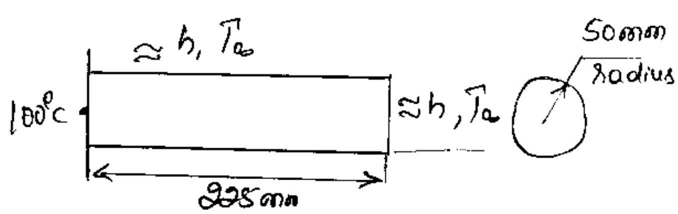

Fig. Q10b

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